

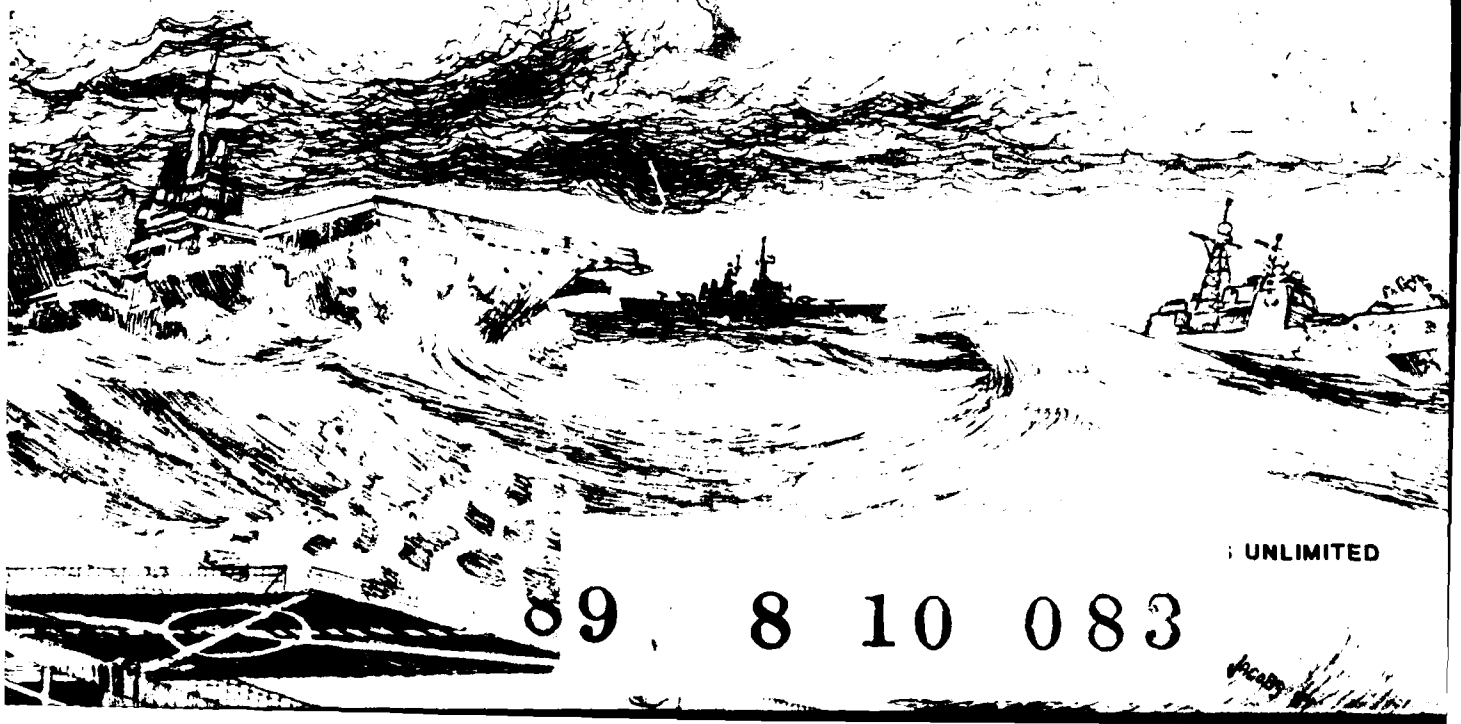
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SEVERE WEATHER GUIDE MEDITERRANEAN PORTS

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19. ABSTRACT (Continue on reverse if necessary and identify by block number) This handbook for the port of Palermo, one in a series of severe weather guides for Mediterranean ports, provides decision-making guidance for ship captains whose vessels are threatened by actual or forecast strong winds, high seas, restricted visibility or thunderstorms in the port vicinity. Causes and effects of such hazardous conditions are discussed. Precautionary or evasive actions are suggested for various vessel situations. The handbook is organized in four sections for ready reference: general guidance on handbook content and use; a quick-look captain's summary; a more detailed review of general information on environmental conditions; and an appendix that provides oceanographic information.					
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CONTENTS

Foreword	iii
Preface	v
Record of Changes	vii
1. GENERAL GUIDANCE	1-1
1.1 Design	1-1
1.1.1 Objectives	1-1
1.1.2 Approach	1-1
1.1.3 Organization	1-2
1.2 Contents of Specific Harbor Studies	1-3
2. Captain's Summary	2-1
3. GENERAL INFORMATION	3-1
3.1 Geographic Location	3-1
3.2 Qualitative Evaluation of the Port of Palermo.	3-4
3.3 Currents and Tides	3-5
3.4 Visibility	3-5
3.5 Hazardous Conditions	3-6
3.6 Harbor Protection	3-9
3.6.1 Wind and Weather	3-9
3.6.2 Waves	3-10
3.7 Protective and Mitigating Measures	3-10
3.7.1 Sortie/Remain in Port	3-10
3.7.2 Moving to a New Anchorage	3-10
3.8 Local Indicators of Hazardous Weather Conditions	3-11
3.9 Summary of Problems, Actions, and Indicators	3-12
References	3-17
Appendix A -- General Purpose Oceanographic Information	A-1

FOREWORD

This handbook on Mediterranean Ports was developed as part of an ongoing effort at the Naval Environmental Prediction Research Facility to create products for direct application to Fleet operations. The research was conducted in response to Commander Naval Oceanography Command (COMNAVOCEANCOM) requirements validated by the Chief of Naval Operations (OP-096).

As mentioned in the preface, the Mediterranean region is unique in that several areas exist where local winds can cause dangerous operating conditions. This handbook will provide the ship's captain with assistance in making decisions regarding the disposition of his ship when heavy winds and seas are encountered or forecast at various port locations.

Readers are urged to submit comments, suggestions for changes, deletions and/or additions to Naval Oceanography Command Center (NAVOCEANCOMCEN), Rota with a copy to the oceanographer, COMSIXTHFLT. They will then be passed on to the Naval Environmental Prediction Research Facility for review and incorporation as appropriate. This document will be a dynamic one, changing and improving as more and better information is obtained.

W. L. SHUTT
Commander, U.S. Navy



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PORT INDEX

The following is a tentative prioritized list of Mediterranean Ports to be evaluated during the five-year period 1988-92, with ports grouped by expected year of the port study's publication. This list is subject to change as dictated by circumstances and periodic review.

1988 NO.	PORT	1990	PORT
1	GAETA, ITALY		TARANTO, ITALY
2	NAPLES, ITALY		ALEXANDRIA, EGYPT
3	CATANIA, ITALY		PORT SAID, EGYPT
4	AUGUSTA BAY, ITALY		ANTALYA, TURKEY
5	CAGLIARI, ITALY		ISKENDERUN, TURKEY
6	LA MADDALENA, ITALY		IZMIR, TURKEY
7	MARSEILLE, FRANCE		GOLCUK, TURKEY
8	TOULON, FRANCE		ISTANBUL, TURKEY
9	VILLEFRANCHE, FRANCE		
10	MALAGA, SPAIN		
11	NICE, FRANCE		
12	CANNES, FRANCE	1991	PORT
13	MONACO		
14	ASHDOD, ISRAEL		ROTA, SPAIN
15	HAIFA, ISRAEL		TANGIER, MOROCCO
16	BARCELONA, SPAIN		ALGIERS, ALGERIA
17	PALMA, SPAIN		TUNIS, TUNISIA
18	IBIZA, SPAIN		BIZERTE, TUNISIA
19	POLLENSA BAY, SPAIN		SFAX, TUNISIA
20	LIVORNO, ITALY		VALETTA, MALTA
21	LA SPEZIA, ITALY		
22	VENICE, ITALY	1992	PORT
23	TRIESTE, ITALY		
24	CARTAGENA, SPAIN		SOUDA BAY, CRETE
25	VALENCIA, SPAIN		PIRAEUS, GREECE
			KALAMATA, GREECE
			THESSALONIKI, GREECE
1989	PORT		CORFU, GREECE
			KITHIRA, GREECE
26	SAN REMO, ITALY		LARNACA, CYPRUS
27	GENOA, ITALY		DUBROVNIK, YUGOSLAVIA
28	PORTO TORRES, ITALY		SPLIT, YUGOSLAVIA
29	PALERMO, ITALY		GULF OF SOLLUM
30	MESSINA, ITALY		
31	TAORMINA, ITALY		
	BENIDORM, SPAIN		

PREFACE

Environmental phenomena such as strong winds, high waves, restrictions to visibility and thunderstorms can be hazardous to critical Fleet operations. The cause and effect of several of these phenomena are unique to the Mediterranean region and some prior knowledge of their characteristics would be helpful to ship's captains. The intent of this publication is to provide guidance to the captains for assistance in decision making.

The Mediterranean Sea region is an area where complicated topographical features influence weather patterns. Katabatic winds will flow through restricted mountain gaps or valleys and, as a result of the venturi effect, strengthen to storm intensity in a short period of time. As these winds exit and flow over port regions and coastal areas, anchored ships with large 'sail areas' may be blown aground. Also, hazardous sea state conditions are created, posing a danger for small boats ferrying personnel to and from port. At the same time, adjacent areas may be relatively calm. A glance at current weather charts may not always reveal the causes for these local effects which vary drastically from point to point.

Because of the irregular coast line and numerous islands in the Mediterranean, swell can be refracted around such barriers and come from directions which vary greatly with the wind. Anchored ships may experience winds and seas from one direction and swell from a different direction. These conditions can be extremely hazardous for tendered vessels. Moderate to heavy swell may also propagate outward in advance of a storm resulting in uncomfortable and sometimes dangerous conditions, especially during tending, refueling and boating operations.

This handbook addresses the various weather conditions, their local cause and effect and suggests some evasive action to be taken if necessary. Most of the major ports in the Mediterranean will be covered in the handbook. A priority list, established by the Sixth Fleet, exists for the port studies conducted and this list will be followed as closely as possible in terms of scheduling publications.

RECORD OF CHANGES

[illegible]

1. GENERAL GUIDANCE

1.1 DESIGN

This handbook is designed to provide ship captains with a ready reference on hazardous weather and wave conditions in selected Mediterranean harbors. Section 2, the captain's summary, is an abbreviated version of section 3, the general information section intended for staff planners and meteorologists. Once section 3 has been read, it is not necessary to read section 2.

1.1.1 Objectives

The basic objective is to provide ship captains with a concise reference of hazards to ship activities that are caused by environmental conditions in various Mediterranean harbors, and to offer suggestions for precautionary and/or evasive actions. A secondary objective is to provide adequate background information on such hazards so that operational forecasters, or other interested parties, can quickly gain the local knowledge that is necessary to ensure high quality forecasts.

1.1.2 Approach

Information on harbor conditions and hazards was accumulated in the following manner:

- A. A literature search for reference material was performed.
- B. Cruise reports were reviewed.
- C. Navy personnel with current or previous area experience were interviewed.
- D. A preliminary report was developed which included questions on various local conditions in specific harbors.
- E. Port/harbor visits were made by NEPRF personnel; considerable information was obtained through interviews with local pilots, tug masters, etc; and local reference material was obtained.
- F. The cumulative information was reviewed, combined, and condensed for harbor studies.

Emphasis is placed on the hazards related to wind, wind waves, and the propagation of deep water swell into the harbor areas. Various vessel locations/situations are considered, including moored, nesting, anchored, arriving/departing, and small boat operations. The potential problems and suggested precautionary/evasive actions for various combinations of environmental threats and vessel location/situation are provided. Local indicators of environmental hazards and possible evasion techniques are summarized for various scenarios.

CAUTIONARY NOTE: In September 1985 Hurricane Gloria raked the Norfolk, VA area while several US Navy ships were anchored on the muddy bottom of Chesapeake Bay. One important fact was revealed during this incident: Most all ships frigate size and larger dragged anchor, some more than others, in winds of over 50 knots. As winds and waves increased, ships 'fell into' the wave troughs, BROADSIDE TO THE WIND and become difficult or impossible to control.

This was a rare instance in which several ships of recent design were exposed to the same storm and much effort was put into the documentation of lessons learned. Chief among these was the suggestion to evade at sea rather than remain anchored at port whenever winds of such intensity were forecast.

2. CAPTAIN'S SUMMARY

The Port of Palermo is located on the north coast of the Italian island of Sicily at approximately $38^{\circ}08'N$ $13^{\circ}22'E$ (Figure 2-1).

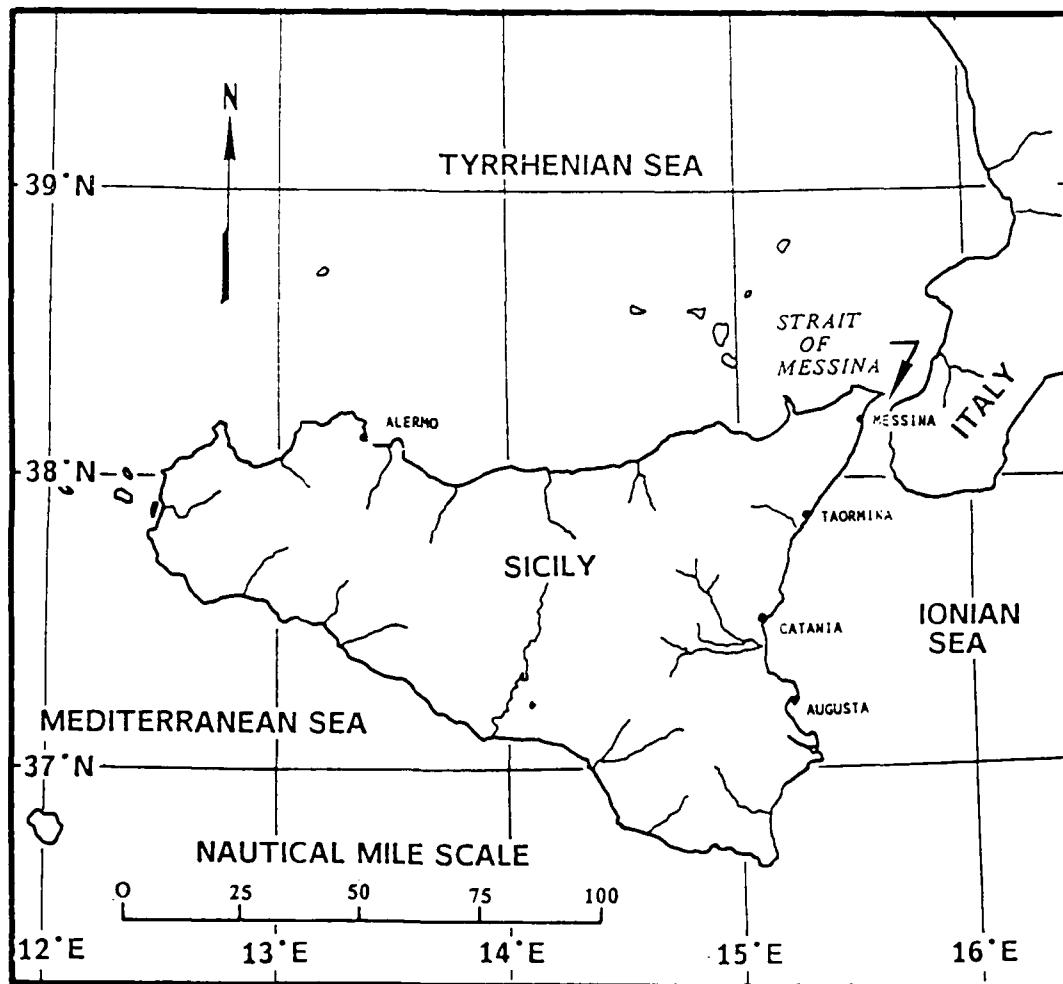


Figure 2-1. The Island of Sicily and Surrounding Seas.

The Port is situated between Punta del Corsaro and Punta Arenella on the west side of Golfo di Palermo (Figure 2-2). Steeply rising terrain lies close to Palermo on the south, west, and northwest sides of the Port. A valley extends a few miles southwestward from Palermo, but quickly loses its identity in the rising terrain. Elevations commonly exceed 1,640 ft (500 m) within 5 n mi of the Port, with some peaks extending well above 2,800 ft (853 m).

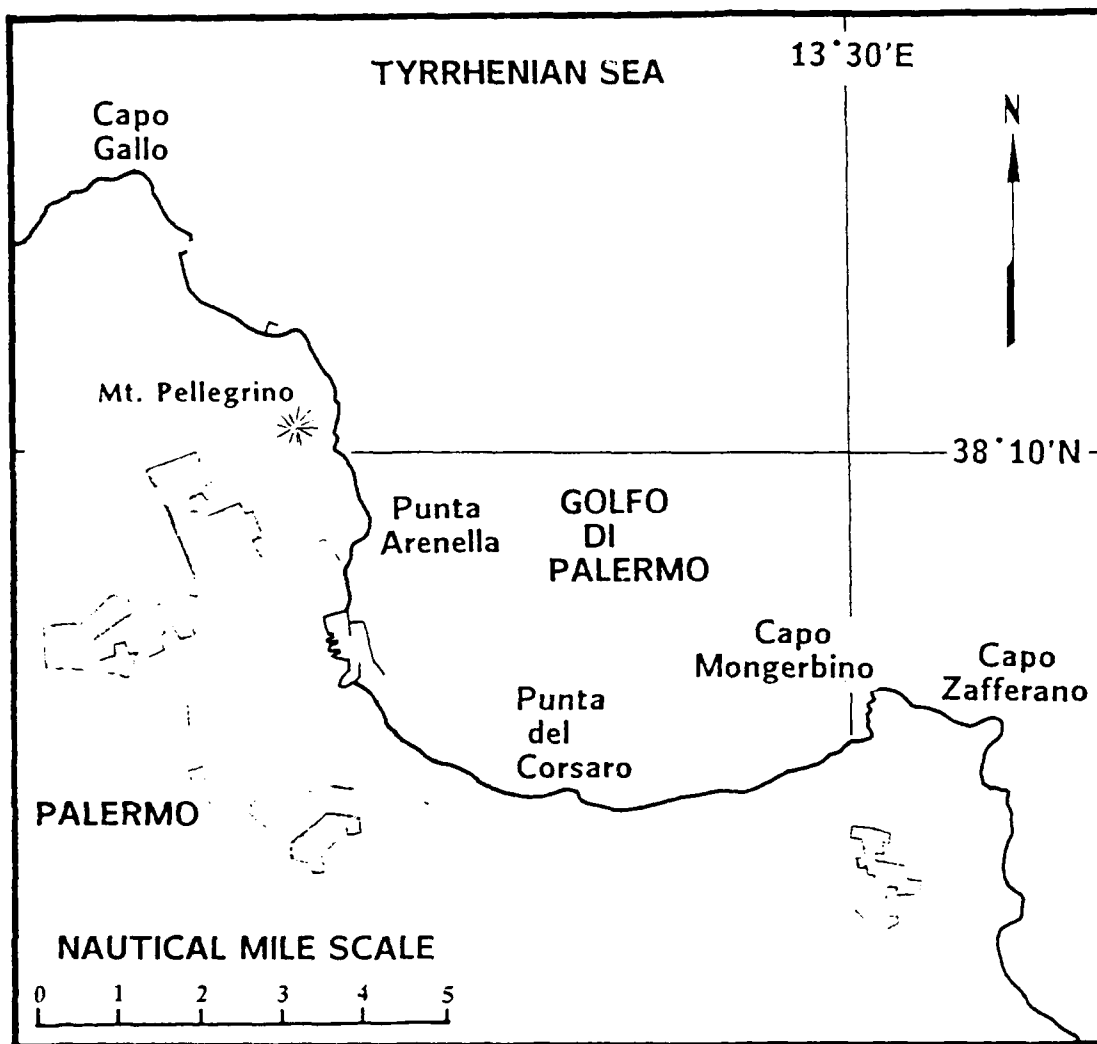


Figure 2-2. Approaches to Palermo.

The main harbor at the Port of Palermo is entered through an 840 ft (256 m) wide entrance which passes between Diga Foranea and the north end of Molo Sud (FICEURLANT, 1987). See Figure 2-3. The harbor is formed and protected by Diga Foranea, Molo Martello, Molo Nord, and Molo Sud.

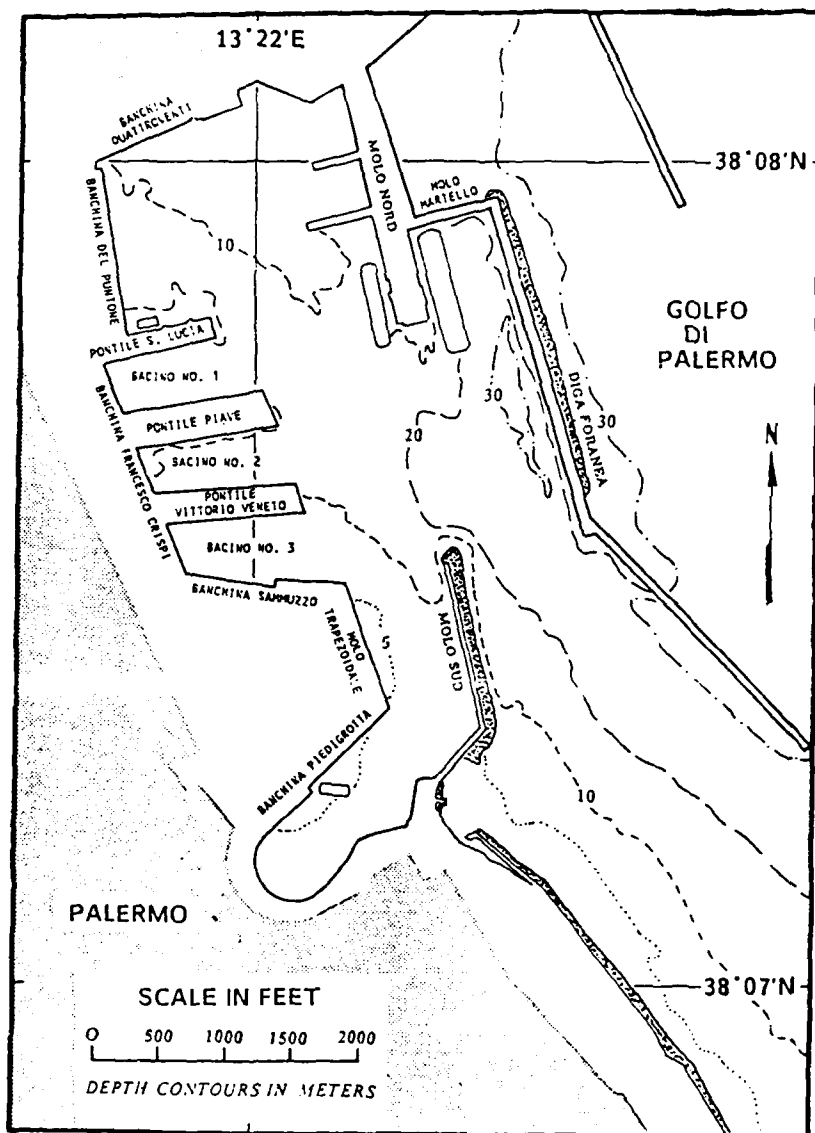


Figure 2-3. Palermo Harbor.

The Port of Palermo is considered to be a "deep draft" port, and has berths capable of accommodating aircraft carriers. About 10 large ships can be handled at any one time. Due to the limited berthing space, normal pier side visits are limited to 3 days, but visits can be extended if space allows (FICEURLANT, 1987). According to local authorities, smaller ships moor at Banchina Quattroventi or Pontile Vittorio Veneto, but other berths can be used if needed and available. But the Port Directory for Palermo, Sicily, Italy, (FICEURLANT, 1987) states: "Once inside the inner breakwater, Med mooring to north mole is required.... Depth at north mole is sufficient to moor stern first for most destroyer type ships."

Anchorage are assigned by port authorities. Local authorities state that anchoring can be anywhere within the harbor complex. However, in the Mediterranean Pilot (Hydrographic Department, 1963) it states that holding ground in the harbor is bad, but good holding ground can be found outside the harbor, and in depths of 9 to 10 fm (16.5 to 18.3 m) about 3 to 6 n mi east of the Port.

Local mariners state that, except for a 2 to 3 kt current which enters the harbor toward Banchina Quattroventi during southeasterly Scirocco winds, currents are negligible. Tidal range inside the harbor is less than 1 ft (0.3 m) year round (FICEURLANT, 1987).

Specific hazardous conditions, vessel situations, and suggested precautionary/evasive action scenarios are summarized in Table 2-1.

Table 2-1. Summary of hazardous environmental con

HAZARDOUS CONDITION	INDICATORS OF POTENTIAL HAZARD	VESSEL SITUATION
<p>1. <u>NE-E winds/waves</u> - Known as Gregale (NE) or Levante (E).</p> <ul style="list-style-type: none"> * Most common October to May period. * Strong outbreak has wind of 30-40 kt, with maximum of 50 kt. * Waves are normally 6 ft (2 m), but waves to 13 ft (4 m) are possible. 	<p><u>Advance warning</u></p> <ul style="list-style-type: none"> * Low clouds on Mt. Pellegrino, a 1,968 ft (600 m) steep, barren mountain just N of the Port, indicates NE-E wind will occur within 24 hr. <p><u>Duration</u></p> <ul style="list-style-type: none"> * May last 1 to 5 days, depending on cause. 	<p>(1) <u>Mod</u></p> <p>(2) <u>And</u> <u>bre</u></p> <p>(3) <u>Arr</u></p> <p>(4) <u>Sma</u></p>
<p>2. <u>SE winds</u> - Known as Scirocco.</p> <ul style="list-style-type: none"> * Most common October to mid-May period. * Offshore component precludes significant wave generation at the Port. * Brings hot, dry weather to N coast of Sicily. 	<p><u>Advance warning</u></p> <ul style="list-style-type: none"> * Low clouds in thin bands to the east or south of Palermo indicate the start of a Scirocco within 12 to 24 hr. <p><u>Duration</u></p> <ul style="list-style-type: none"> * Normally lasts about 3 days. <p><u>Changes in wind</u></p> <ul style="list-style-type: none"> * Dense belts of altocumulus castellanus approaching from SW are at times associated with radical and sudden changes in both wind direction and speed. 	<p>(1) <u>Mod</u></p> <p>(2) <u>And</u> <u>bre</u></p> <p>(3) <u>Arr</u></p> <p>(4) <u>Sma</u></p>

1 of 2

ental conditions for the Port of Palermo, Sicily, Italy.

VESSEL LOCATION/ SITUATION AFFECTED	EFFECT - PRECAUTIONARY/EVASIVE ACTIONS
<p>(1) <u>Moored - Inner harbor.</u></p> <p>(2) <u>Anchored - outside breakwaters.</u></p> <p>(3) <u>Arriving/departing.</u></p> <p>(4) <u>Small boats.</u></p>	<p>a. <u>The inner harbor affords good protection from waves, but offers little protection from wind.</u> * Vessels should double mooring lines.</p> <p>a. <u>The waters outside the breakwater system offer no protection from winds or waves.</u> * Unless a strong outbreak is forecast, good holding ground should enable ships to remain at anchor. * Two anchors may be required. * If a strong outbreak is expected, ships should weigh anchor and move to a berth in the inner harbor or evade at sea.</p> <p>a. <u>Strong winds/high waves pose problems for ships entering or leaving the harbor.</u> * It is possible to leave the harbor during strong winds (45 kt or greater) but entering the Port would be very difficult. * Entering or leaving the harbor during periods of high waves would be difficult. * Ships could anchor, provided winds/waves were not high and 2 anchors were used to forestall dragging. * If a strong event is expected, vessels should accelerate or delay arrival/departure to avoid the strongest conditions.</p> <p>a. <u>Boat runs to/from anchorages outside the breakwaters should be curtailed until conditions abate.</u> * Boating in the inner harbor should not be affected.</p>
<p>(1) <u>Moored - Inner harbor.</u></p> <p>(2) <u>Anchored - outside breakwaters.</u></p> <p>(3) <u>Arriving/departing.</u></p> <p>(4) <u>Small boats.</u></p>	<p>a. <u>The current induced by the wind reaches Banchina Quattroventi.</u> * The current causes ships moored to the quay to pound against it unless precautions are taken. Proper use of an anchor will prevent the pounding. * Banchina Quattroventi is the only quay affected.</p> <p>a. <u>The offshore component of the wind precludes significant wave generation in the coastal waters.</u> * Since the anchorages offer no protection from a SE wind, two anchors may be required to prevent dragging in a strong event.</p> <p>a. <u>Strong winds (45 kt or greater) make it very difficult to enter the harbor, but departures would still be possible.</u> * If a strong event is expected, vessels should accelerate or delay arrival/departure to avoid the strongest conditions. * Inbound units assigned to Banchina Quattroventi should be aware of the problems posed by the wind generated current and deploy an anchor as necessary. See 2(1)a. above.</p> <p>a. <u>Boat runs to/from anchorages outside the breakwaters should be curtailed until conditions abate.</u> * Boating in the inner harbor should not be affected.</p>

SEASONAL SUMMARY OF HAZARDOUS WEATHER CONDITIONS

WINTER (November through February)

- * Northeast to east winds: Called Gregale (northeast) or Levante (east), the winds create the worst conditions at Palermo. Wind speeds are typically 35 to 40 kt, with a maximum of 50 kt. Waves are usually 6 ft (2 m) but waves to 13 ft (4 m) are possible. May be caused by high pressure over central Europe or the Balkans and low pressure over North Africa near Libya, or the passage of a low pressure system moving eastward south of Sicily. Duration may vary from 1 to 5 days depending on cause. Low clouds on Mt. Pellegrino (located just north of the Port) indicates Gregale/Levante winds will occur within 24 hours.
- * Southeast winds: Called Scirocco. Little effect on the Port, except for a 2-3 kt induced current which reaches Banchina Quattroventi. Sciroccos may occur anytime but are most common from October to mid-May, and normally last about 3 days. Low clouds in thin bands to the east or south indicate the start of a Scirocco within 12 to 24 hours. Scirocco conditions crossing Sicily produce strong and gusty foehn-type winds on the north and east sides of the island. It has been noted that during these situations, ships experience better weather south of Sicily than north of the island. Sea conditions, however, would be better north of Sicily due to the short fetch (Brody and Nestor, 1980). During a Scirocco, dense belts of altocumulus castellanus approaching from the southwest are at times associated with radical and sudden changes in both the direction and speed of the wind.

SPRING (March through May):

- * Early spring conditions are much the same as winter. Most of the bad weather at Palermo is over by the end of May.
- * Early morning visibility is infrequently (2 to 3 times per year) reduced to near zero in fog, usually in May.

SUMMER (June through September):

- * Summer weather is generally good with light winds.

AUTUMN (October):

- * Short transition season with winter-like weather returning by the end of the month.

NOTE: For more detailed information on hazardous weather conditions, see previous Table 2-1 in this section and Hazardous Weather Summary in Section 3.

REFERENCES

FICEURLANT, 1979 reissued 1987: Port Directory for Palermo, Sicily, Italy. Fleet Intelligence Center Europe and Atlantic, Norfolk, VA.

Hydrographic Department, 1963: Mediterranean Pilot. Volume I. Hydrographer of the Navy, London, England.

PORT VISIT INFORMATION

MAY 1988. NEPRF Meteorologists R. Fett and D. Perryman met with Pilots Mr. Tralongo and Mr. Porretto to obtain much of the information included in this port evaluation.

3.

GENERAL INFORMATION

This section is intended for Fleet meteorologists/oceanographers and staff planners. Paragraph 3.5 provides a general discussion of hazards and Table 3-1 provides a summary of vessel locations/situations, potential hazards, effects, precautionary/evasive actions, and advance indicators and other information by season.

3.1

Geographic Location

The Port of Palermo is located on the north coast of the Italian island of Sicily at approximately 38°08'N 13°22'E (Figure 3-1).

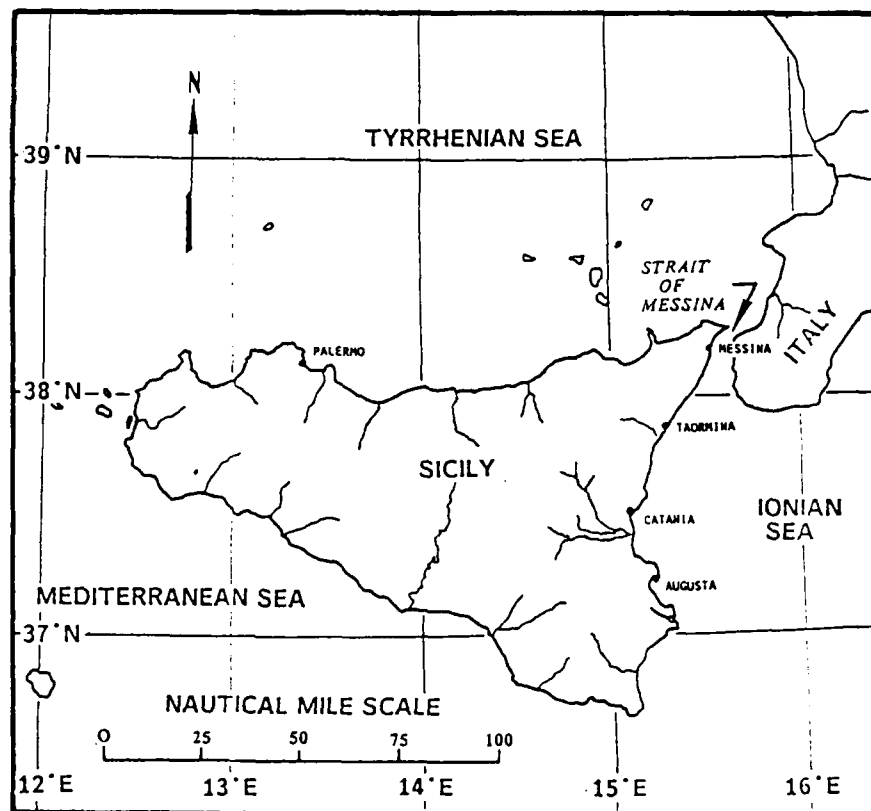


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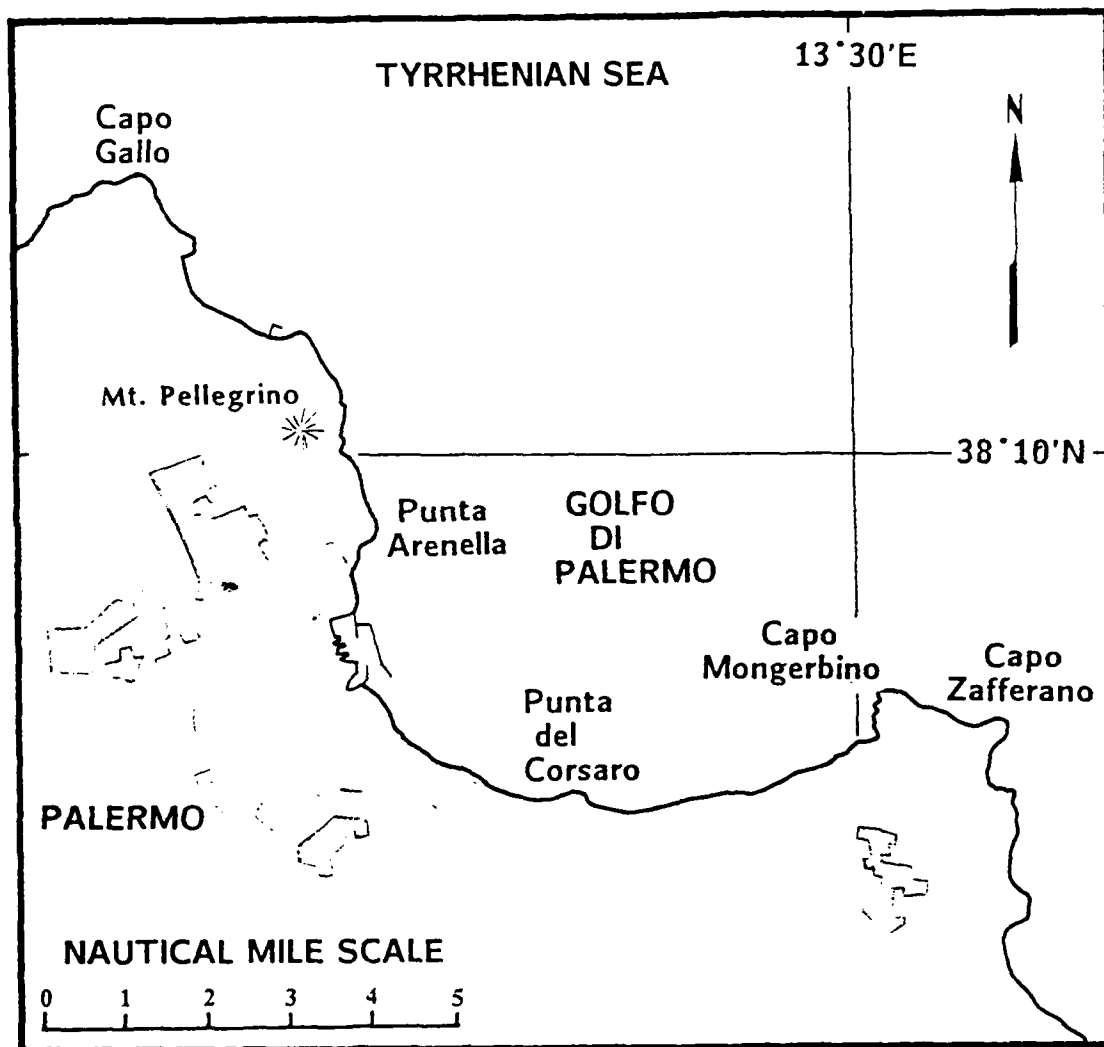


Figure 3-2. Approaches to Palermo.

The main harbor at the Port of Palermo is entered through an 840 ft (256 m) wide entrance which passes between Diga Foranea and the north end of Molo Sud (FICEURLANT, 1987). See Figure 3-3. The harbor is formed and protected by Diga Foranea, Molo Martello, Molo Nord, and Molo Sud.

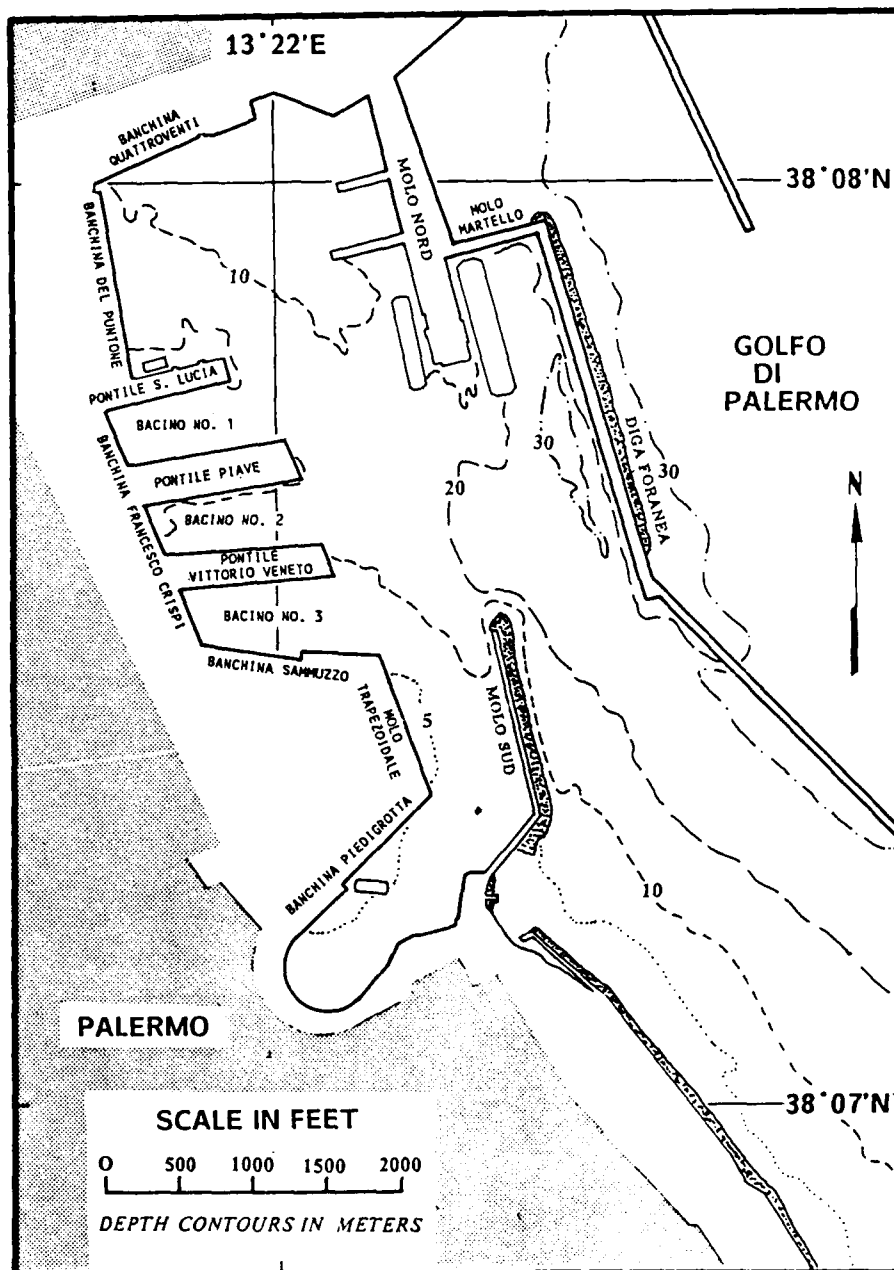


Figure 3-3. Palermo Harbor.

The Port of Palermo is considered to be a "deep draft" port, and has berths capable of accommodating aircraft carriers. About 10 large ships can be handled by the harbor at any one time. Due to the limited berthing space, normal pier side visits are limited to 3 days, but visits can be extended if space allows (FICEURLANT, 1987). According to local authorities, smaller ships moor at Banchina Quattroventi or Pontile Vittorio Veneto, but other berths can be used if needed and available. But the Port Directory for Palermo, Sicily, Italy, published in 1979 and reissued in 1987 by Fleet Intelligence Center Europe and Atlantic, Norfolk, VA states: "Once inside the inner breakwater, Med mooring to north mole is required.... Depth at north mole is sufficient to moor stern first for most destroyer type ships."

Anchorage are assigned by port authorities, and are not indicated on charts. Local authorities state that anchoring can be anywhere within the harbor complex. However, Mediterranean Pilot, Volume I, published by the Hydrographic Department, London, England in 1963, states that holding ground in the harbor is bad, but good holding ground can be found outside the harbor, and in depths of 9 to 10 fm (16.5 to 18.3 m) about 3 to 6 n mi east of the Port along the coast.

3.2 Qualitative Evaluation of the Port of Palermo

Most of the inner harbor at the Port offers excellent protection from heavy weather because of the orientation of the breakwater system. The harbor is exposed to winds from the northeast quadrant, but waves from the same quadrant have little effect on inner harbor operations. Precautionary actions, such as

doubling of mooring lines, will allow ships to remain in port during strong winds. Entering and leaving the Port is difficult during high wave conditions. Southeasterly Scirocco winds do cause problems for ships using Banchina Quattroventi. Due to the location and orientation of the Port entrance, a strong Scirocco outbreak generates a 2 to 3 kt current which enters the harbor and reaches ships moored to Banchina Quattroventi. The current impacts the ships on the beam and pounds them against the pier unless precautions are taken. Local authorities say the pounding can be eliminated by proper use of an anchor. The problem is unique to Banchina Quattroventi. The anchorages outside the harbor are exposed and vulnerable to winds and waves from the northeast quadrant, and to southeasterly Scirocco winds.

3.3 Currents and Tides

Local authorities state that, except for a 2 to 3 kt current which enters the harbor toward Banchina Quattroventi (see section 3.2 above), currents are negligible. Tidal range inside the harbor is less than 1 ft (0.3 m) year round (FICEURLANT, 1987).

3.4 Visibility

Visibility at Palermo is generally good, reducing to less than 2 n mi only 2 to 4 days per month. Thick fog will reduce visibility to near zero 2 or 3 times per year, usually in May. Lowest visibility normally occurs in early morning and is of short duration.

Hazardous Conditions

The Port of Palermo is well protected from the effects of most hazardous weather scenarios. The protective breakwater system affords good protection from hazardous waves, but offers little protection from wind.

Although rare, storms having tropical cyclone characteristics with fully developed eyes have been observed on at least three occasions in the Mediterranean Basin: 23-26 September 1969, 22-28 January 1982, and 26-30 September 1983. On the latter occasion the storm moved northwest from the Gulf of Gabes (on the southeast coast of Tunisia), through the Straits of Sicily, along the east coast of Sardinia, and into the Gulf of Genoa. Winds of 100 kt were observed near the eye, while Cagliari, Sardinia reported winds of 60 kt. While the probability of such a storm striking Palermo is remote, the meteorologist must be aware of the possibility.

A seasonal summary of various known environmental hazards that may be encountered in the Port of Palermo follows.

A. Winter (November through February)

The most adverse weather conditions at the Port of Palermo are caused by east (Levante) to northeast (Gregale) winds. Winds during a strong event are typically 35 to 40 kt, with a maximum velocity of about 50 kt. Waves generated by the winds are usually about 6 ft (2 m), but waves to 13 ft (4 m) are possible. Waves from northeast to east are the only ones which affect port operations, as they make entering and leaving the Port difficult. If wind speed reaches 45 kt or more, it would be possible to exit the Port area but very

difficult to enter. East to northeasterly winds may result from high pressure over central Europe or the Balkans and low pressure over north Africa near Libya, or with the passage of a low pressure system as it moves eastward south of Sicily (Reiter, 1975). These winds could also occur in advance of encroaching high pressure following a cold frontal passage through the region. The high winds may persist for 24 hours if they result from a transient low pressure system, or up to 5 days if due to building high pressure north of Sicily and a low pressure system over North Africa.

Southeasterly Scirocco winds reach the Port area, but have little effect due to their offshore component, other than the current problem at Banchina Quattroventi. Scirocco events may occur during any month of the season and usually last about 3 days. A Scirocco is normally caused by a well developed low pressure system over North Africa or winds within the warm sector of a low pressure system. Due to a foehn effect, a Scirocco will result in high temperatures and low humidity along the north coast of Sicily, even during general overall conditions of fog and low stratus (Brody and Nestor, 1980).

Temperatures during the winter season are mild, mean maximum and minimum temperatures range from 68°F (20°C) and 51°F (11°C) in November to 58°F (14°C) and 42°F (6°C) in January, the coldest month. The lowest temperature recorded at Palermo during one 30-year period of record was 29°F (-2°C).

Precipitation is at its yearly maximum during December, when the average rainfall total is 4.5 inches. Thunderstorms are not common nor severe, occurring on 1 or 2 days of each month during the season. Snowfall is uncommon.

B. Spring (March through May)

Early spring weather at Palermo is similar to that of winter, but quickly moderates as the season progresses. Gale frequency is the highest of the year in March (0.6 days per month), but drops to zero days in May. Most Scirocco events are over by mid-May. The gradual northward migration of the jet stream and the associated Polar front reduces the likelihood of extratropical storm activity near Sicily as summer approaches.

Early morning visibility may be reduced to near zero on 2 or 3 days each year, usually in May.

Temperatures warm significantly during the season to mean daily maximum and minimum temperatures of 74°F (23°C) and 54°F (12°C) by the end of May.

Precipitation amounts decrease throughout the season, with May averaging only 1.1 inches accumulation.

C. Summer (June through September)

Strong winds are rare at Palermo during the summer season, with no gale force winds recorded for June through August during a 5-year period of record. September did experience gale force winds, but in each instance the wind was from the southeast or south, offshore flow that would have minimal impact on port operations.

Mean daily maximum and minimum temperatures are 81°F (31°C) and 65°F (18°C) during July and August, the warmest months of the year.

Precipitation is at a yearly minimum during July, with only 0.2 inches accumulating during an average month. By September, however, the monthly average increases to 2 inches.

D. Autumn (October)

As is the case over much of the region, the autumn season is limited to the single month of October. The transition to winter-type weather occurs rapidly as the extratropical storm track moves southward. The potential for gale force winds increases as low pressure systems again move through the Mediterranean Basin.

Daily temperatures gradually decrease, while precipitation amounts increase significantly, with an accumulation of 3.7 inches being average for the month.

3.6 Harbor Protection

As detailed below, the inner harbor at the Port of Palermo offers good protection from most hazards, but ships anchored outside the protective breakwaters are largely exposed and vulnerable to strong winds and waves.

3.6.1 Wind and Weather

The Port of Palermo is exposed to wind from the northeast quadrant, but wind alone causes few problems at the Port. Ships berthed in the inner harbor can double mooring lines and remain alongside. Ships moored to Banchina Quattroventi may need to deploy an anchor to reduce pounding caused by a current. Strong wind is from the southeast (Scirocco). Inbound or outbound ships may experience problems. It is possible to depart the harbor during high winds, but entering is very difficult.

Ships anchored outside the breakwaters may experience wind related problems, but none were mentioned by local authorities during on-site interviews. Anchor dragging would be a potential

problem in a strong wind, but a second anchor on the good holding bottom may forestall even that hazard.

3.6.2 Waves

Vessels moored in the inner harbor should experience no problems from waves. North and northeast waves are the only waves affecting port operations; entering and leaving the Port is made difficult because of high waves. Similarly, high waves from north or northeast may place ships which are anchored outside the breakwaters in a hazardous position, as the wind and wave forces would tend to force vessels toward the coast if anchor dragging should occur.

3.7 Protective and Mitigating Measures

3.7.1 Sortie/Remain in Port

Ships moored in the inner harbor should find no need to sortie if strong winds are forecast. Mooring lines should be doubled.

3.7.2 Moving to a New Anchorage

Unless a strong event with high waves is forecast, ships anchored outside the harbor should be able to remain. A second anchor may be advisable. Although it may be possible to remain at anchor in a strong event, weighing anchor and moving to a berth in the inner harbor or evading at sea should be considered.

Northeast to East Gregale/Levante Winds

Low clouds on Mt. Pellegrino indicates Gregale/Levante winds will occur within 24 hours. Mt. Pellegrino is a 1,968 ft (600 m) steep, barren mountain with a dark red color located just north of the Port.

Southeasterly Scirocco winds

Low clouds in thin bands to the east or south of Palermo indicate the start of a Scirocco within 12 to 24 hours. Increasing southerly winds at coastal stations along the northeast coast of Libya indicate the start of a Scirocco (Brody and Nestor, 1980).

Forecast a strong Scirocco if two conditions are met: (1) an upper trough is present over the Balkans with a strong jet stream along its southern boundary; and (2) large pressure falls (after the diurnal pressure change is removed) are observed at stations along the east coast of Tunisia (Brody and Nestor, 1980).

Scirocco conditions crossing Sicily produce strong and gusty foehn-type winds on the north and east sides of the island. High temperatures and low humidity can be expected even during general conditions of fog and low stratus. It has been noted that during these situations, ships experience better weather conditions south of Sicily than north of the island. Sea conditions, however, would be better north of Sicily due to the short fetch (Brody and Nestor, 1980).

During a Scirocco, dense belts of altocumulus castellanus approaching from the southwest, probably associated with weak upper-level troughs, are at times associated with radical and sudden changes in direction and speed of the wind (Brody and Nestor, 1980).

The surface inversion that occurs over the relatively cool water during a spring Scirocco causes

extremely anomalous radar and radio propagation in the dust-laden atmosphere below the inversion; helicopters are liable to be out of radio contact at a range of 1-2 n mi (Brody and Nestor, 1980).

Weather associated with a Scirocco is largely dependent on both the length of the wind's overwater trajectory and the wind speed. High wind speeds and short overwater trajectories produce large amounts of dust that reduce visibilities, while low wind speeds and long overwater trajectories produce high humidities with fog and poor visibilities (Brody and Nestor, 1980).

3.9

Summary of Problems, Actions, and Indicators

Table 3-1 provides easy-to-use seasonal references for meteorologists on ships using the Port of Palermo. Table 2-1 (Section 2) summarizes Table 3-1 and is intended primarily for use by ship captains.

Table 3-1. Potential problem situations at Port of

VESSEL LOCATION/ SITUATION AFFECTED	POTENTIAL HAZARD	EFFECT - PRECAUTIONARY/EV
<p>1. <u>Moored - Inner harbor.</u></p> <p>Occurs all seasons, less common in summer.</p> <p>Occurs all seasons, less common in summer.</p>	<p>a. <u>NE-E'ly winds/waves</u> - Called Gregale (NE) or Levante (E), the winds create the worst conditions for the Port. A strong outbreak will produce winds of 30-40 kt with a maximum of 50 kt. Waves are usually 6 ft (2 m) but waves to 13 ft (4 m) are possible. Most common during October-May period. Duration may range from 1 to 5 days, depending on cause.</p> <p>b. <u>SE'ly winds</u> - Called Scirocco. Wind alone has little effect on Port operations, and lack of fetch precludes wave generation at the Port. The wind generates a 2-3 kt current which enters the harbor. Scirocco events may occur during any month, but are most common during October to mid-May period. Duration is normally about 3 days. Scirocco events bring high temperatures and low humidity to the N coast of Sicily.</p>	<p>a. The inner harbor at Palermo is well protected and is exposed to wind. The harbor is safe, however, moored vessels should remain at their berths when strong winds are expected. Mooring lines should be doubled.</p> <p>b. The current reaches Banchina Quattroventi and vessels moored to the quay to pound against it unless they are taken. Local authorities state that proper mooring will eliminate the problem. Other piers are not affected. The spring inversion that occurs over the harbor during a spring Scirocco causes extremely anomalous radio propagation in the dust-laden atmosphere below 200 ft; helicopters are liable to be out of radio contact at 2 n mi.</p>
<p>2. <u>Anchored - Outside breakwaters.</u></p> <p>Occurs all seasons, less common in summer.</p> <p>Occurs all seasons, less common in summer.</p>	<p>a. <u>NE-E'ly winds/waves</u> - Called Gregale (NE) or Levante (E), the winds create the worst conditions for the Port. A strong outbreak will produce winds of 30-40 kt with a maximum of 50 kt. Waves are usually 6 ft (2 m) but waves to 13 ft (4 m) are possible. Most common during October-May period. Duration may range from 1 to 5 days, depending on cause.</p> <p>b. <u>SE'ly winds</u> - Called Scirocco. Wind alone has little effect on Port operations, and lack of fetch precludes wave generation at the Port. The wind generates a 2-3 kt current which enters the harbor. Scirocco events may occur during any month, but are most common during October to mid-May period. Duration is normally about 3 days. Scirocco events bring high temperatures and low humidity to the N coast of Sicily.</p>	<p>a. The waters outside the protective breakwaters are exposed and vulnerable to the winds and waves. The harbor is good, however, and unless a strong event is expected, vessels should be able to remain at anchor. Two anchors may be used. If a strong event is expected, weighing anchor and moving to the inner harbor or evading at sea should be considered.</p> <p>b. The offshore component of the wind precludes wave generation at the potential anchorage sites and vessels should be able to remain at anchor. Two anchors may be used. The surface inversion that occurs over the harbor during a spring Scirocco causes extremely anomalous radio propagation in the dust-laden atmosphere; helicopters are liable to be out of radio contact at a range of 1-2 n mi.</p>

ations at Port of Palermo, Sicily, Italy - ALL SEASONS

PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
<p>bor at Palermo is well protected from waves, but nd. The harbor is safe, however, and ships may berths when strong winds are expected. Mooring doubled.</p> <p>reaches Banchina Quattroventi and causes ships ay to pound against it unless precautions are thorities state that proper use of an anchor will oblem. Other piers are not affected. The surface ccurs over the relatively cool water during a causes extremely anomalous radar and radio he dust-laden atmosphere below the inversion; liable to be out of radio contact at a range of 1-</p> <p>outside the protective breakwater system are erable to the winds and waves. The holding ground , and unless a strong event occurs, ships should in at anchor. Two anchors may be advisable. If a expected, weighing anchor and moving to a berth in or evading at sea should be considered.</p> <p>e component of the wind precludes significant wave ie potential anchorage sites so ships should be it anchor. Two anchors may be required in a strong ace inversion that occurs over the relatively cool ;pring Scirocco causes extremely anomalous radar ation in the dust-laden atmosphere below the :opters are liable to be out of radio contact at a ni.</p>	<p>a. Strong winds from NE or E may result from high pressure over central Europe or the Balkans and low pressure over N Africa near Libya, or by an E moving low pressure system passing S of Sicily. The winds could also occur following the passage of a cold front through the region. Low clouds on Mt. Pellegrino, a 1,968 ft (600 m) steep, barren mountain just N of the Port, indicates NE-E winds will occur within 24 hr.</p> <p>b. Scirocco winds are usually associated with a well-developed low pressure system over N Africa or the warm sector of a low pressure system located N of the Mediterranean Sea which transports the warm air to Sicily. Low clouds in thin bands to the E or S of Palermo indicate the start of a Scirocco within 12 to 24 hr. Increasing S'ly winds at coastal stations along the N coast of Libya indicate the start of a Scirocco. The following conditions indicate a strong Scirocco should be forecast: (1) an upper trough is present over the Balkans with a strong jet stream along its S boundary; and (2) large pressure falls (after the diurnal pressure change is removed) at stations along the E coast of Tunisia. Weather associated with a Scirocco is largely dependent on both the length of the wind's overwater trajectory and the wind speed. High wind speeds and short overwater trajectories produce large amounts of dust that reduce visibilities, while low wind speeds and long overwater trajectories produce high humidities with fog and poor visibilities. During a Scirocco, dense belts of altocumulus castellanus approaching from SW are, at times, associated with radical and sudden changes in both the direction and speed of the wind.</p> <p>a. Strong winds from NE or E may result from high pressure over central Europe or the Balkans and low pressure over N Africa near Libya, or by an E moving low pressure system passing S of Sicily. The winds could also occur following the passage of a cold front through the region. Low clouds on Mt. Pellegrino, a 1,968 ft (600 m) steep, barren mountain just N of the Port, indicates NE-E winds will occur within 24 hr.</p> <p>b. Scirocco winds are usually associated with a well-developed low pressure system over N Africa or the warm sector of a low pressure system located N of the Mediterranean Sea which transports the warm air to Sicily. Low clouds in thin bands to the E or S of Palermo indicate the start of a Scirocco within 12 to 24 hr. Increasing S'ly winds at coastal stations along the N coast of Libya indicate the start of a Scirocco. The following conditions indicate a strong Scirocco should be forecast: (1) an upper trough is present over the Balkans with a strong jet stream along its S boundary; and (2) large pressure falls (after the diurnal pressure change is removed) at stations along the E coast of Tunisia. Weather associated with a Scirocco is largely dependent on both the length of the wind's overwater trajectory and the wind speed. High wind speeds and short overwater trajectories produce large amounts of dust that reduce visibilities, while low wind speeds and long overwater trajectories produce high humidities with fog and poor visibilities. During a Scirocco, dense belts of altocumulus castellanus approaching from SW are, at times, associated with radical and sudden changes in both the direction and speed of the wind.</p>

Table 3-1. (Continued)

PRECAUTIONARY/EVASIVE ACTIONS	ADVANCE INDICATORS AND OTHER INFORMATION ABOUT POTENTIAL HAZARD
<p>It may be possible to leave the harbor during periods of 5 kt or more), it would be very difficult to depart the harbor is difficult during a heavy sea. Inbound/outbound vessels should be aware and plan to arrive/depart the Port well in advance of high winds/waves, or wait until conditions improve. Units desiring to anchor could use the anchorages, in accordance with the provisions of 2.a above.</p> <p>When approaching 45 kt, entering/leaving the harbor is a problem. If winds of 45 kt are expected, inbound vessels may be able to enter the harbor, but departures would be difficult. Inbound ships assigned to Banchina should be aware of the possible pounding caused by the SE wind. See 1.b above. The surface current flows over the relatively cool water during a heavy sea causes extremely anomalous radar and radio returns due to the dust-laden atmosphere below the inversion; vessels may be liable to be out of radio contact at a range of 1-2 miles.</p> <p>The inner harbor should not be significantly affected by winds to/from vessels anchored outside the harbor. Vessels may have to be curtailed until conditions abate.</p>	<p>a. Strong winds from NE or E may result from high pressure over central Europe or the Balkans and low pressure over N Africa near Libya, or by an E moving low pressure system passing S of Sicily. The winds could also occur following the passage of a cold front through the region. Low clouds on Mt. Pellegrino, a 1,968 ft (600 m) steep, barren mountain just N of the Port, indicates NE-E winds will occur within 24 hr.</p> <p>b. Scirocco winds are usually associated with a well-developed low pressure system over N Africa or the warm sector of a low pressure system located N of the Mediterranean Sea which transports the warm air to Sicily. Low clouds in thin bands to the E or S of Palermo indicate the start of a Scirocco within 12 to 24 hr. Increasing S'ly winds at coastal stations along the N coast of Libya indicate the start of a Scirocco. The following conditions indicate a strong Scirocco should be forecast: (1) an upper trough is present over the Balkans with a strong jet stream along its S boundary; and (2) large pressure falls (after the diurnal pressure change is removed) at stations along the E coast of Tunisia. Weather associated with a Scirocco is largely dependent on both the length of the wind's overwater trajectory and the wind speed. High wind speeds and short overwater trajectories produce large amounts of dust that reduce visibilities, while low wind speeds and long overwater trajectories produce high humidities with fog and poor visibilities. During a Scirocco, dense belts of altocumulus castellanus approaching from SW are, at times, associated with radical and sudden changes in both the direction and speed of the wind.</p> <p>a. Strong winds from NE or E may result from high pressure over central Europe or the Balkans and low pressure over N Africa near Libya, or by an E moving low pressure system passing S of Sicily. The winds could also occur following the passage of a cold front through the region. Low clouds on Mt. Pellegrino, a 1,968 ft (600 m) steep, barren mountain just N of the Port, indicates NE-E winds will occur within 24 hr.</p>

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PORT VISIT INFORMATION

MAY 1988. NEPRF Meteorologists R. Fett and D. Perryman met with Pilots Mr. Tralongo and Mr. Porretto to obtain much of the information included in this port evaluation.

APPENDIX A

General Purpose Oceanographic Information

This section provides some general definitions regarding waves and is extracted from H.O. Pub. No. 603, Practical Methods for Observing and Forecasting Ocean Waves (Pierson, Neumann, and James, 1955).

Definitions

Waves that are being generated by local winds are called "SEA". Waves that have traveled out of the generating area are known as "SWELL". Seas are chaotic in period, height and direction while swell approaches a simple sine wave pattern as its distance from the generating area increases. An in-between state exists for a few hundred miles outside the generating area and is a condition that reflects parts of both of the above definitions. In the Mediterranean area, because its fetches and open sea expanses are limited, SEA or IN- BETWEEN conditions will prevail. The "SIGNIFICANT WAVE HEIGHT" is defined as the average value of the heights of the one-third highest waves. PERIOD and WAVE LENGTH refer to the time between passage of, and distances between, two successive crests on the sea surface. The FREQUENCY is the reciprocal of the period ($f = 1/T$) therefore as the period increases the frequency decreases. Waves result from the transfer of energy from the wind to the sea surface. The area over which the wind blows is known as the FETCH, and the length of time that the wind has blown is the DURATION. The characteristics of waves (height, length, and period) depend on the duration, fetch, and velocity of the wind. There is a continuous generation of small short waves from the time the wind starts until it stops. With continual transfer of energy from the wind to the sea surface the waves grow with the older waves leading the growth and spreading the energy over a greater range of frequencies. Throughout the growth cycle a SPECTRUM of ocean waves is being developed.

A Beaufort Scale table with related wave effects is shown on the following page.

BEAUFORT SCALE

Beaufort Number	Wind Speed		Seaman's term	Effects observed at sea	Term and height of waves in meters
	Knots	MPH			
0	Under 1	Under 1	Calm	Sea like mirror.	Calm, glassy, 0
1	1-3	1-3	Light air	Ripples with appearance of scales; no foam crests.	Rippled, less than 0.5
2	4-6	4-7	Light breeze	Small wavelets; crests of glassy appearance, not breaking	Smooth, 0.5
3	7-10	8-12	Gentle breeze	Large wavelets; crests begin to break; scattered whitecaps.	Slight, 1.0
4	11-16	13-18	Moderate breeze	Small waves, becoming longer; numerous whitecaps.	Moderate, 1.0-2.5
5	17-21	19-24	Fresh breeze	Moderate waves, taking longer form; many whitecaps; some spray.	Rough, 2.5-4.0
6	22-27	25-31	Strong breeze	Larger waves forming; whitecaps everywhere; more spray.	Very rough, 4.0-6.0
7	28-33	32-38	Moderate gale	Sea heaps up; white foam from breaking waves begins to be blown up in streaks.	
8	34-40	39-46	Fresh gale	Moderate high waves; edges of crests begin to break; foam is blown in streaks.	
9	41-47	47-54	Strong gale	High waves; sea begins to roll; dense streaks of foam; spray may reduce visibility.	
10	48-55	55-63	Whole gale	Very high waves with overhanging crests; sea takes white appearance as foam is blown in very dense streaks; rolling is heavy and visibility reduced.	
11	56-63	64-72	Storm	Exceptionally high waves; sea covered with white foam patches; visibility still more reduced.	
12	64-71	73-82	Hurricane	Air filled with foam; sea completely white with driving spray; visibility greatly reduced. Winds of force 12 and above very rarely experienced on land; usually accompanied by widespread damage.	
13	72-80	83-92			Very high, 9.0-13.5
14	81-89	93-103			Phenomenal, greater than 13.5
15	90-99	104-114			
16	100-108	115-125			
17	109-118	126-136			

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29L1	Frigate LANT (FF 1078/1097 Class)
29N1	Submarine LANT #SSN}
29Q	Submarine LANT SSBN
29R1	Battleship Lant (2)
29AA1	Guided Missile Frigate LANT (FFG 7)
29BB1	Guided Missile Destroyer (DDG 993)
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31B1	Amphibious Cargo Ship LANT
31G1	Amphibious Transport Ship LANT
31H1	Amphibious Assault Ship LANT (2)
31I1	Dock Landing Ship LANT
31J1	Dock Landing Ship LANT
31M1	Tank Landing Ship LANT
32A1	Destroyer Tender LANT
32C1	Ammunition Ship LANT
32G1	Combat Store Ship LANT
32H1	Fast Combat Support Ship LANT
32N1	Oiler LANT
32Q1	Replenishment Oiler LANT
32S1	Repair Ship LANT
32X1	Salvage Ship LANT

32DD1 Submarine Tender LANT
 32EE1 Submarine Rescue Ship LANT
 32KK Miscellaneous Command Ship
 32QQ1 Salvage and Rescue Ship LANT
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Oceanografia, 80133 Napoli
Via Amm, Acton, 38 Italy

Director, SACLANT ASW
Research Centre
Viale San Bartolomeo, 400
I-19026 La Spezia, Italy

NAVENVPREDRSCHFAC
Attn: D. Perryman,
Wea. Anal. Fcst.
Monterey, CA 93943-5006

Director, Institute of
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Washington, DC 20560

Science Applications
Intl. Corp. (SAIC)
205 Montecito Ave.
Monterey, CA 93940

Mr. Dick Gilmore
2145 N. Fairway Ct.
Oak Harbor, WA 98277

Director of Naval Oceano.
& Meteorology
Ministry of Defence
Old War Office Bldg.
London, S.W.1. England

Belgian Air Staff
VS3/CTL-MET
Everestraat 1
1140 Brussels
Belgium

Library, Institute of
Oceanographic Sciences
Attn: Director
Wormley, Godalming
Surry GU8 5UB, England

Service Hydrographique EtT
Oceanographique De La Marine
Etablissement Principal
Rue Du Chatellier, B.P. 426
29275 - Brest Cedex, France

Direction De La Meteorologie
Attn: J. Dettwiller, MN/RE
77 Rue De Sevres
92106 Boulogne-Billancourt
Cedex, France

Institut fur Meereskunde
An Der Universitat Kiel
Dusternbrooker Weg 20
23 Kiel
Federal Republic of Germany

Director, Deutsches
Hydrographisches Institut
Tauschstelle, Postfach 220
02000 Hamburg 4
Federal Republic of Germany

Commander, D.W. Taylor
Naval Ship Center
Surface Ship Dynamics Br.
Attn: S. Bales
Bethesda, MD 20084-5000

Director
NAVSURFWEACEN, White Oaks
Navy Science Asst. Program
Silver Spring, MD 20903-5000

3350TH Tech. Trng Group
TTGU/2/STOP 623
Chanute AFB, IL 61868

U.S. Army Research Office
Attn: Geophysics Div.
P.O. Box 12211
Research Triangle Park, NC

Director
Library, Tech. Info. Cen.
Army Eng. Waterways Station
Vicksburg, MS 39180

Director, Env. & Life Sci.
Office of Undersec of Defense
for Rsch. & Env. E&LS
Rm. 3D129, The Pentagon
Washington, DC 20301

Director, Tech. Information
Defense Adv. Rsch. Projects
1400 Wilson Blvd.
Arlington, VA 22209

Chief, Marine Sci. Section
U.S. Coast Guard Academy
New London, CT 06320

Commander
NAVSURFWEACEN, Code R42
Dr. Katz, White Oaks Lab
Silver Spring, MD 20903-5000

Drector, Atlantic Marine
Center, NOAA
Coast & Geodetic Survey,
9 W. York St.
Norfolk, VA 23510

Asst. for Env. Sciences
Asst. SECNAV (R&D)
Room 5E731, The Pentagon
Washington, DC 20350

Office of Naval Research
Code 1122AT, Atmos. Sciences
Arlington, VA 22217-5000

Jefe del, Servicio de Aplica.
Aeronauticas y Maritimas
Instituto Nacional de Meteoro
Calle Universitaria
Apartado 285, 28071 Madrid
Espana SPAIN

The Joint Staff (J-3/ESD)
Environmental Services Div.
Operations Directorate
Washington, DC 20318-3000

Danish Defence Weather Serv.
Chief of Defence
P.O. Box 202
DK-2950 vedbaek DENMARK

Superintendent
Library Reports
U.S. Naval Academy
Annapolis, MD 21402

Director of Research
U.S. Naval Academy
Annapolis, MD 21402

NAVPGSCOL
Attn: Library
Monterey, CA 93943-5002

Commander
Naval Safety Center
Naval Air Station
Norfolk, VA 23511

Federal Coord. for Meteoro.
Servs. & Sup. Rsch. (OFCM)
11426 Rockville Pike, Rm 300
Rockville, MD 20852

Director
National Oceano. Data Center
E/OC23, NOAA
Washington, DC 20235